

## DISCUSSION

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Census taking and evaluation have a short history in most developing countries, and indeed many such countries have taken their first censuses only recently. With little first-hand experience, developing countries often take advantage of outside technical assistance, for instance from such organizations as the United Nations Statistical Office and the U.S. Bureau of the Census. In this way, they build indirectly on other countries' experiences. The three papers under discussion all stem from such outside assistance.

Census taking in developing countries has its own special problems beyond those encountered in most developed countries and, since a census is itself a type of survey, these problems extend to surveys also. The problems frequently include, for instance: multiple languages and dialects; lack of skilled staff; poor road systems and lack of suitable transport; lack of adequate computing facilities; poor maps; nomadic populations; lack of knowledge about ages and other items by many members of the population; and difficulties with the concept of "household" as used in censuses and surveys in most developed countries. Since such problems are common to many developing countries, there is much to be gained by sharing experiences in dealing with them. There are, however, few forums available for the discussion of census and survey methodology in developing countries. I welcome the presence of the current session on the ASA program, and I hope that sessions on similar topics will be held in future years. I believe that the ASA can make a useful contribution to the development of census and survey methodology in developing countries by this means.

The three papers in this session are all concerned with the evaluation of censuses. As they note, census evaluation may be broadly divided into an evaluation of coverage and an evaluation of content. Census evaluation may be used to give a measurement of the level of accuracy of the census, to adjust the census results, and to identify sources of error so that the quality of future censuses and surveys may be improved.

As with a survey, there are a number of possible methods for evaluating a census. The methods include:

1. Checks of internal consistency. Such checks include, for example, analyses of sex ratios by age, age distributions by single years (for age heaping). Unlikely findings may be the result of either content or coverage errors.
2. Checks of external consistency against aggregate data. These checks include demographic analysis, in which a balancing equation is developed to calculate the current population from a past population with allowance for births, deaths, immigration and emigration.
3. Checks of external consistency against individual data. Census returns can be checked against an alternative source of individual data (e.g., tax records, school enrollments, birth records) to study both content and coverage errors.
4. Re-enumeration studies. These are commonly known as post enumeration surveys (PES's) or post enumeration checks (PEC's). Several different types of PES may be distinguished: those aiming at a similar level of quality to that of the census; those aiming at a higher level of quality; and those that are part of another survey.
5. Interpenetrated (replicated) studies. These studies may be used to measure such quantities as enumerator variance or coder variance. They require random assignment of, for instance, enumerators' loads in parts of the census.
6. In-depth studies. These studies are anthropological in nature. They may be used to investigate both content and coverage errors through a detailed study of some small geographical areas.

I assume that all countries carry out checks on the internal consistency of their census data. As Gnanasekaran and Clague show in their paper, the post enumeration survey is the main other census evaluation method used in developing countries. A few countries use demographic analysis, but its use is restricted by the lack of external aggregate data of good quality. The predominance of the PES is understandable, but as discussed below it has its limitations.

Among the other methods, I will comment only on in-depth studies. An example of this type of study is a sociological study that was conducted to obtain information on the nature of population undercoverage in difficult-to-enumerate areas in the 1970 U.S. Census. The study was carried out in an inner city area by a social scientist who resided in the area. Although such in-depth studies cannot produce statistical estimates of the general extent of coverage or content errors, I believe that they have real potential for identifying and understanding some major sources of error. This can be extremely valuable for the avoidance of these errors in future censuses and surveys. In-depth studies may be able to generate particularly helpful insights into coverage and content errors in censuses and surveys in developing countries.

Gnanasekaran and Clague's study provides an interesting account of the range of practices employed in the conduct of post enumeration surveys in developing countries, and gives some illustrations. They draw attention to the fact that a PES needs to be executed properly if its results are to be useful and point out that some countries have switched to other methods because of problems with a PES. A potentially valuable extension to their study would be to carry out a detailed examination of a selection of post enumeration surveys to determine how successful they were, what problems were encountered, and how the problems related to the practices adopted. The results of such an examination might prove helpful in improving procedures for future post enumeration surveys. As Larson observes, a post enumeration survey is not a small operation: it resembles a major national survey, and then painstaking attention must be given to the matching operation. Undoubtedly a basic requirement for a successful PES is that sufficient resources are available to conduct it effectively.

Cowan, Turner and Stanecki describe dual system estimation which is commonly used with post enumeration surveys. A critical assumption with the standard dual system estimation procedure is independence between the PES and the census. In developing countries, it seems to me that the practice of having enumerators write numbers on buildings during the census is likely to be a particular threat to the independence assumption, since the PES enumerators will also use these numbers. Although the numbers are helpful for matching, they may well influence the PES enumerators in their identification of occupied dwellings and in their determination of the boundaries of the enumeration areas.

Other major assumptions with dual system estimation include perfect matching of PES and census records, no duplicate or other erroneous listings, and that nonrespondents to the PES and to the census can be matched. In practice, the matching operation is problematic and very time-consuming. Larson provides a good discussion of the matching operation in the Bangladesh post enumeration surveys, including the benefits of a field follow-up of "non-match" cases.

In addition to coverage evaluation, Larson also reports some findings on the PES content evaluation of the Bangladesh censuses. By collecting more elaborate information than the census on land use, the PES for the Agricultural Census pointed to some systematic errors in the Census. This brings out a notable advantage of collecting high quality data in the PES.

The planned PES for Somali described by Cowan, Turner and Stanecki is a challenging undertaking. In addition to the usual problems encountered in conducting a PES, this survey will have to contend with the facts that about half the population is nomadic, and that the censuses for the settled and nomadic populations are being conducted at different times. The matching of nomads between the PES and the census may prove to be extremely difficult, and there does not appear to be an opportunity for a field follow-up of "non-match" cases. The assumption that the names of household heads and household compositions will always enable matches to be made seems open to serious doubt. The split of the census between two dates raises concerns about duplicate listings for persons enumerated in the settled areas in November, 1986 and in the nomadic population in February, 1987. In theory duplicates should be identifiable by the proposed procedures of asking the nomads where they were in November and conducting secondary matches to opposing

areas for subsamples from the two component PES's, but I am uncertain how well these procedures will work. There is also the risk that some persons may be missed entirely, being nomads in November and in the settled population in February. The current procedures do not seem to permit the number of entirely missed persons to be estimated. A method for estimating this number would be to take a PES sample of the settled areas in February.

In conclusion, the PES is the major tool for census evaluation in developing countries, and it seems likely to remain so for some time. However, a PES needs to be conducted with care and thoroughness, and it needs adequate financial and other resources. Even then, using the PES with dual system estimation remains problematic, and in particular there is the serious risk that correlation bias will lead to a substantial underestimate of the census undercount. Given the importance of the PES in census evaluation programs in developing countries, more research on the PES is needed.